DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the device which made possible resistance spot welding of the weldment which carried out complicated shape especially about the device which can perform resistance spot welding continuously via a metallic foil.
[0002]
[Description of the Prior Art]The welding process which faces carrying out resistance spot welding of the surface treated steel sheet with which surface treatments, such as galvanization, were performed, and pressurized the electrode via the metallic foil is indicated by JP,57-17390,A. It is possible to roll round in the welding process indicated by this gazette, whenever it welds band-like copper foil, and to weld in an always new copper foil portion.
[0003]When assembling the body of vehicles, many numbers of welding RBIs are needed, and consumption of the electrode tip part of a resistance spot welding machine becomes intense so much. Therefore, in order to secure fixed welding quality, it is necessary to raise the replacement frequency of an electrode and to maintain the optimal welding current density, or complicated control to which welding current is made to increase according to expansion of the diameter of an electrode by consumption of an electrode tip is also needed.
[0004]However, raising the replacement frequency of an electrode makes the working ratio of a device fall, and it poses a problem. Since it becomes the welding current control based on presumption of the wear degree of an electrode to the last when making welding current increase according to expansion of the diameter of an electrode by consumption, considering complicated control, it is unreliable. Then, if a metallic foil is made to infix between an electrode and a welding material and it is made to perform resistance spot welding like the gazette mentioned above, consumption of an electrode can be controlled and it will become possible to maintain the optimal welding current density over a long period of time.
[0005]
[Problem(s) to be Solved by the Invention]However, although the welding process shown in JP,57-17390,A is a technique effective in controlling electrode wear and raising an electrode life, and it does not spread in a factory line, there are the following reasons. At the production plant of a car, there are many members which the job shop type production is performed, and a variety of weldments existed, and moreover carried out complicated shape. Therefore, it is difficult for there to be almost no field which can be used in the case of the device which can respond only to mere monotonous resistance

welding, and to introduce into actual production as indicated by the above-mentioned gazette. Thus, in conventional technology, development of the device which can apply the correspondence to the member which carried out various complicated shape also with the weldment which carried out difficult and complicated shape technically is desired.

[0006]Most is automated or fully automated, and welding operation, such as a vehicle body in the production plant of a car, needs to interrupt welding automatically, when the metallic foil rolled round when it is welding operation like the above-mentioned gazette has cut enough on the way and welds. Therefore, in welding by making a metallic foil intervene between an electrode and a welding material, the function in which these troubles can also be coped with is needed.

[0007]This invention can respond also to the spot welding of the weldment of various complicated shape paying attention to the above-mentioned problem, And it aims at providing the electrode protection instrument for resistance spot welding which can cope with this promptly even when abnormalities occur in rolling up of the metallic foil infixed between an electrode and a weldment.

[0008]

[Means for Solving the Problem]An electrode protection instrument for resistance spot welding concerning this invention in alignment with this purpose, The 1st band-like conducting material that is provided in the upper electrode side and consists of metallic foils, and the 1st rolling-up means that is provided in said upper electrode side and rolls round said 1st band-like conducting material, The 1st guide means to which it shows said 1st band-like conducting material along an outside surface of said upper electrode, The 2nd band-like conducting material that is provided in the lower electrode side which counters said upper electrode and is arranged, and consists of metallic foils, The 2nd rolling-up means that is provided in said upper electrode side and rolls round said 2nd band-like conducting material, While performing drive controlling of the 2nd guide means to which it shows said 2nd band-like conducting material along an outside surface of said lower electrode, said 1st rolling-up means, and said 2nd rolling-up means, this -- even if there is no ** of the 1st rolling-up means and said 2nd rolling-up means, a thing possessing a control means which detects abnormalities in rolling up of said band-like conducting material from one of running torque values is comprised.

[0009]

[Function]In the electrode protection instrument for resistance spot welding constituted in this way, the 1st band-like conducting material provided in the upper electrode side is rolled round by the 1st rolling-up means, and the 2nd band-like conducting material provided in the lower electrode side is rolled round by the 2nd rolling-up means. By rolling round the 1st band-like conducting material and the 2nd band-like conducting material, between an upper electrode and a welding material and between a lower electrode and a welding material, the part of an always new band-like conducting material will be located, the direct contact of an electrode and a weldment is avoided, and consumption of each electrode is controlled.

[0010]Since the 1st band-like conducting material is guided so that the outside surface of an upper electrode may be met by the 1st guide means, and the 2nd band-like conducting material is guided so that the outside surface of a lower electrode may be met by the 2nd guide means, Even if the weldment is carrying out complicated shape, it becomes possible to locate an upper electrode and a lower electrode in the joining section of a request of a weldment. Therefore, even if it uses a metallic foil, it is lost that resistance-spot-welding work is restricted with the shape of a weldment, and correspondence of it is enough attained also at production of a variety small quantity.

[0011]When drive controlling of the 1st rolling-up means and the 2nd rolling-up means is carried out by the control means and either running torque values of the 1st rolling-up means and the 2nd rolling-up means differ greatly compared with the time of normal, the abnormalities in rolling up of a band-like conducting material are detected by the control means.
[0012]When the abnormalities in rolling up are detected, it is in the state which the band-like conducting material has cut enough on the way, or the band-like conducting material is welding.
Resistance-spot-welding work can be interrupted based on this abnormality detecting.
Therefore, it is lost that resistance-spot-welding work is done without infixing a band-like conducting material, and welding quality is maintained uniformly.
[0013]
[Example]Below, the desirable example of the electrode protection instrument for resistance spot welding concerning this invention is described with reference to drawings.
[0014]1st example drawing 1 thru/or drawing 6 show the 1st example of this invention. One shows the welding gun of the resistance spot welding machine among the figure. The welding gun 1 has a C type frame, and the pressurizing cylinder for electrode application of pressure (graphic display abbreviation) is attached to the upper bed part of a frame. The welding gun 1 moves along with the weldment 10 which consists of the sheet metal steel plates 10a and 10b with an industrial robot (graphic display abbreviation) in this example. The upper electrode holder 2 is formed in one side of the phlegm of the welding gun 1.
The lower electrode holder 3 is formed in another side of the frame.

[0015]The upper electrode holder 2 is equipped with the upper electrode 5 which consists of a copper system alloy via the shank 4. The lower electrode holder 3 is equipped with the lower electrode 7 which consists of a copper system alloy via the shank 6 similarly. The tip part of the upper electrode 5 and the lower electrode 7 is formed in approximate sphere surface state.
[0016]The electrode protection instrument 11 is formed in the welding gun 1. The electrode protection instrument 11 has the 1st band-like conducting material 21, the 1st rolling-up means 31, the 1st guide means 41, the 2nd band-like conducting material 51, the 2nd rolling-up means 61, the 2nd guide means 71, and the control means 81.
[0017]The 1st band-like conducting material 21 consists of a copper system metallic foil of tape shape, one side is twisted around the reel 22, and another side is twisted around the reel 23. The reels 22 and 23 are held enabling free rotation to the 1st conducting material cassette 24. The 1st conducting material cassette 24 comprises insulators, such as a synthetic resin. The 1st guide means 41 is attached to the 1st conducting material cassette 24.
[0018]The 1st guide means 41 comprises two or more rollers 42a thru/or 42f. Among these, the rollers 42a, 42b, and 42c which function as a roller for tension adjustment as shown in drawing 3 are located in the reel 22 and 23 side.
The rollers 42d, 42e, and 42f which function as a roller for guidance are located in the upper electrode 5 side.
The rollers 42d, 42e, and 42f which function as a roller for guidance are arranged, respectively left-hand side and on the right-hand side of the upper electrode 5.
[0019]The roller 42d is arranged at the root portion of the shank 4 holding the upper electrode 5. The roller 42e is arranged near the outside surface located in the axial center of the upper electrode 5. The

roller 42f is arranged near the apical surface of the upper electrode 5. As shown in drawing 3, the 1st band-like conducting material 21 by the side of the reel 22 is rolled round along the outside surface of the shank 4 and the upper electrode 5 at the reel 23 side by arranging two or more rollers 42d, 42e, and 42f the shank 4 and near the outside surface of the upper electrode 5.

[0020]In this example, the physical relationship of each rollers 42d, 42e, and 42f formed in the 1st conducting material cassette 24 side, and the shank 4 and the upper electrode 5 which are provided in the welding gun 1 side is constant. Therefore, the 1st band-like conducting material 21 is positioned by the position to the shank 4 and the upper electrode 5 only by equipping the welding gun 1 side with the 1st conducting material cassette 24.

[0021]The 2nd band-like conducting material 51 consists of a copper system metallic foil of tape shape, one side is twisted around the reel 52, and another side is twisted around the reel 53. The reels 52 and 53 are held enabling free rotation to the 2nd conducting material cassette 54. The 2nd conducting material cassette 54 comprises insulators, such as a synthetic resin. The 2nd guide means 71 is attached to the 2nd conducting material cassette 54.

[0022]The 2nd guide means 71 comprises two or more rollers 72a thru/or 72g. Among these, the rollers 72a, 72b, and 72c which function as a roller for tension adjustment as shown in drawing 4 are located in the reel 52 and 53 side.

The rollers 72d, 72e, 72f, and 72g which function as a roller for guidance are located in the lower electrode 7 side.

The rollers 72d, 72e, 72f, and 72g which function as a roller for guidance are arranged, respectively left-hand side and on the right-hand side of the lower electrode 7.

[0023]The rollers 72d and 72e are arranged at the root portion of the shank 6 holding the lower electrode 7. The roller 72f is arranged near the outside surface located in the shaft-orientations middle of the lower electrode 5. The roller 72g is arranged near the apical surface of the lower electrode 7. As shown in drawing 4, the 2nd band-like conducting material 51 by the side of the reel 52 is rolled round along the outside surface of the shank 6 and the lower electrode 7 at the reel 53 side by arranging two or more rollers 72, 72e, 72f, and 72g the shank 6 and near the outside surface of the upper electrode 7.

[0024]In this example, the physical relationship with the shank 6 and the lower electrode 7 which are provided in the each roller [which are formed in the 2nd conducting material cassette 54 side]d [72],e [72],f [72], and 72g and welding gun 1 side is constant. Therefore, the 2nd band-like conducting material 51 is positioned by the position to the shank 6 and the lower electrode 7 only by equipping the welding gun 1 side with the 2nd conducting material cassette 54.

[0025]The 1st rolling-up means 31 is attached to the upper electrode 5 side of the welding gun 1. The 1st rolling-up means 31 comprises the stepping motor 32, the torque sensor 33, the connecting shaft 34, and the driven shaft 35. The torque sensor 33 is connected with the output shaft of the stepping motor 32. The connecting shaft 34 which can engage with the circumference of the reel 23 of the 1st conducting material cassette 24 and an axial center is attached to the axis end of the torque sensor 33. The reel 22 can engage with the circumference of the driven shaft 35 supported by the bearing (graphic display abbreviation) enabling free rotation and an axial center. Drive controlling of the stepping motor 32 is carried out by the control means 81 mentioned later.

[0026]The 2nd rolling-up means 61 is attached to the lower electrode 7 side of the welding gun 1. The 2nd rolling-up means 61 comprises the stepping motor 62, the torque sensor 63, the connecting shaft 64, and the driven shaft 65. The torque sensor 63 is connected with the output shaft of the stepping motor

62. The connecting shaft 64 which can engage with the circumference of the reel 53 of the 2nd conducting material cassette 54 and an axial center is attached to the axis end of the torque sensor 63. The reel 52 can engage with the circumference of the driven shaft 65 supported by the bearing enabling free rotation and an axial center. Drive controlling of the stepping motor 62 is carried out by the control means 81 mentioned later.

[0027]Drawing 5 shows the control means 81 which performs drive controlling of the 1st rolling-up means 31 and the 2nd rolling-up means 61. The control means 81 has the programmable logic controller 82, the stepping motor control section 83, and the torque test section 84. The stepping motor control section 83 and the torque test section 84 are electrically connected with the programmable controller 82. The stepping motor 32 by the side of the upper electrode 5 and the stepping motor 62 by the side of the lower electrode 7 carry out a rotation drive based on the output signal from the stepping motor control section 83.

[0028]The signal from the torque sensor 33 by the side of the upper electrode 5 and the signal from the torque sensor 63 by the side of the lower electrode 7 are inputted into the torque test section 84, respectively. The torque test section 84 judges with rolling up being unusual, when the running torque value based on the signal from each torque sensors 33 and 63 is substantially changed to a preset value, and it outputs that to the programmable logic controller 82.

[0029]Thus, each band-like conducting materials 21 and 51 are turned off on the way, and when running torque became small, or each band-like conducting materials 21 and 51 weld 10 and running torque becomes large conversely, the torque test section 84 detects the abnormalities in rolling up, and has a function which outputs a signal to that effect. The maximum running torque value Tmax and the minimum running torque value Tmin used as a rolling-up abnormality judgement standard are beforehand calculated in the experiment.
This reference value is memorized by the torque test section 84.

[0030]The programmable logic controller 82 has the function to calculate the amount of rolling up of the 1st band-like conducting material 21 and the 2nd band-like conducting material 51. The value which broke the total length of each band-like conducting materials 21 and 51 by rolling-up control of each band-like conducting materials 21 and 51 in the amount of rolling up per time, That is, the total number-of-times of rolling up N_T is calculated, and when the number of times N of rolling up for every welding reaches the total number-of-times of rolling up N_T, it is judged that rolling up was completed.

[0031]When the number of times N of rolling up reaches the total number-of-times of rolling up N_T, While rolling round from the programmable logic controller 82 to the stepping motor control section 83, outputting a completion signal and stopping rolling up of each band-like conducting materials 21 and 51 by each stepping motors 32 and 62, The resistance-spot-welding work by a robot is interrupted. The signal from the external operation switch 91 can be inputted into the programmable logic controller 82. It is also possible to roll round the band-like conducting materials 21 and 51 using information other than a running torque value, or to interrupt rolling up in case of emergency.

[0032]Below, it explains, referring to drawing 6 for the operation in this example. If the weldments 10, such as a vehicle body, are conveyed to a position, the welding gun 1 will be moved toward the weldment 10 by the robot which is not illustrated. If positioning of the welding gun 1 over the weldment

10 is completed, a welding seizing signal will be outputted and resistance spot welding will be started.
[0033]If a welding seizing signal is outputted, the upper electrode 5 will descend by the pressurizing cylinder which was attached to the welding gun 1 and which is not illustrated, and the weldment 10 will be pressurized with the upper electrode 5 and the lower electrode 7. Junction of the weldment 10 which consists of the sheet metal steel plates 10a and 10b which welding current was sent between the upper electrode 5 and the lower electrode 7 in this state, for example, were galvanized is performed. Since the 1st band-like conducting material 21 intervenes between the upper electrode 5 and the weldment 10 and the 2nd band-like conducting material 51 intervenes between the lower electrode 7 and the weldment 10 here, Carrying out direct contact of the upper electrode 5 and the lower electrode 7 to the weldment 10 is lost, and consumption of each electrodes 5 and 7 is controlled.
[0034]If the spot welding of a particular part is completed, the upper electrode 5 can pull up by a pressurizing cylinder (graphic display abbreviation). If the upper electrode 5 can pull up, while the 1st band-like conducting material 21 will be rolled round by the stepping motor 32 at the reel 23 side, the 2nd band-like conducting material 51 is rolled round by the stepping motor 62 at the reel 53 side. Therefore, the part of the 1st always new band-like conducting material 21 will contact the upper electrode 5, and the 2nd always new band-like conducting material 51 will contact the lower electrode 7. The number of times N of rolling up of the band-like conducting materials 21 and 51 by each stepping motors 32 and 62 is counted with the programmable logic controller 82.
[0035]If welding of a particular part is completed, the welding gun 1 will be moved by the robot to the next joint. In this case, the 1st band-like conducting material 21 is guided so that the outside surface of the shank 4 and the upper electrode 5 may be met by the 1st guide means 41, Since the 2nd band-like conducting material 51 is guided so that the outside surface of the shank 6 and the lower electrode 7 may be met by the 2nd guide means 71, even if the weldment 10 is carrying out complicated shape, it becomes possible to locate the upper electrode 5 and the lower electrode 7 in the joined part of a request of the weldment 10.
[0036]Drawing 6 shows the procedure of rolling-up control of each band-like conducting material by the 1st rolling-up means 31 and the 2nd rolling-up means 61. In Step 101 of drawing 6, control management is started, it rolls round spontaneously to Step 102, and the number of times N is set to 0. When the number of times N of rolling up is set to 0, it progresses to Step 103 and 1 is added to the number of times N of rolling up. Next, it progresses to Step 104 and the application-of-pressure cancer opening signal as a welding completion signal is inputted.
[0037]If an application-of-pressure cancer opening signal is inputted, it will progress to Step 105, a rotation start signal will be outputted to each stepping motors 32 and 62 from the control means 81, and rolling up of each band-like conducting materials 21 and 51 will be performed. Next, it progresses to Step 106 and the judgment of the size of running torque T is performed in the torque test section 84 based on the signal from each torque sensors 33 and 63.
[0038]Here, when it is judged that the running torque value based on the signal from one of torque sensors is smaller than the minimum running torque value Tmin at least, a band-like conducting material presumes that it went out on the way, and progresses to Step 109. In Step 109, the signal of the purport that the band-like conducting material was turned off on the way is outputted to the programmable logic controller 82 from the torque test section 84, and rolling up of the band-like conducting material by the step motors 32 and 62 is stopped.
[0039]In Step 106, when it is judged that the running torque value based on the signal from one of

torque sensors is larger than the maximum running torque value Tmax at least, one of the band-like conducting materials 21 and 51 presumes that it welded 10, and progresses to Step 110. At Step 110, the signal of the purport that the band-like conducting material welded is outputted to the programmable logic controller 82 from the torque test section 84, and rolling up of the band-like conducting material by the step motors 32 and 62 is stopped.

[0040]In Step 106, when the running torque value T based on the signal from each torque sensors 33 and 63 is judged to be between the minimum running torque value Tmin and the maximum running torque value Tmax, it progresses to Step 107. In Step 107, judgment whether the number of times N of rolling up by the step motors 32 and 62 reached the total number-of-times of rolling up T_T is performed. When the number of times N of rolling up has not reached the total number-of-times of rolling up N_T, it returns to Step 103 here, and above-mentioned processing is loop food ****.

[0041]In Step 107, when it is judged that the number of times N of rolling up reached the total number-of-times of rolling up N_T, it progresses to Step 108 and the signal of the purport that rolling up is completed is outputted to the stepping motor control section 83 from the programmable logic controller 82. By this, rolling up of each band-like conducting materials 21 and 51 by the stepping motors 32 and 62 is stopped, it rolls round spontaneously to Step 111, and processing of control is ended.

[0042]If rolling up of each band-like conducting materials 21 and 51 is stopped by rolling-up completion, the 1st conducting material cassette 24 and the 2nd conducting material cassette 54 with which the welding gun 1 side was equipped will be removed by it, and it will be equipped with the 1st new conducting material cassette 24 and the 2nd conducting material cassette 54. If equipped with each conducting material cassettes 24 and 54, resistance spot welding will be started again and each band-like conducting material 21 and 51 rolling up will be performed.

[0043]Since the physical relationship of the rollers 42d, 42e, and 42f of the 1st guide means 41 provided in the 1st conducting material cassette 24 side, and the shank 4 and the upper electrode 5 which are provided in the welding gun 1 side is constant here, The setting work of the 1st conducting material cassette 24 becomes unnecessary [new positioning of the 1st / as opposed to the shank 4 and the upper electrode 5 only in mere mounting work / band-like conducting material 21]. About the setting work of the 2nd conducting material cassette 54 as well as the 1st conducting material cassette 24, it becomes unnecessary [mere mounting work / positioning of the 2nd band-like conducting material 51].

[0044]Drawing 7 shows the case where the electrode protection instrument of this invention is applied to welding of aluminum system metal. Since the tip diameter of an electrode becomes large by consumption as the number of welding RBIs increases when not using an electrode protection instrument as shown in the feature 1 of drawing 7, welding current density becomes small and it will have an adverse effect on weld strength.

[0045]On the other hand, like this invention, when the band-like conducting materials 21 and 51 are made to intervene between each electrodes 5 and 7 and the weldment 10, as shown in drawing 7, even if the number of welding RBIs increases, almost changing of the tip diameter of each electrodes 5 and 7 is lost. therefore, it becomes possible to maintain welding current density at about 1 law also to use of the long period of time of an electrode, and improvement in welding quality can be aimed at. When applying to the surface treated steel sheet with which especially surface treatments, such as galvanization, were performed, adhesion of the zinc to an electrode tip part is avoided thoroughly, and the remarkable fall of the electrode life by alloying of an electrode tip part can be prevented.

[0046]2nd example drawing 8 shows the 2nd example of this invention. Since the place where the 2nd example differs from the 1st example is only arrangement of the shape of an upper electrode and a lower electrode, and the roller of the guide means to which it shows a band-like conducting material and other portions apply to the 1st example correspondingly, Explanation of the portion which applies correspondingly by giving the same numerals as the 1st example to the portion which applies correspondingly is omitted, and only a different portion is explained. Other examples mentioned later are made the same.

[0047]Although the tip shape of the upper electrode 5 and the lower electrode 7 was formed in sphere form in the 1st example, the tip part of the upper electrode 5 is formed in edge shape in this example. That is, one field of the tip part of the upper electrode 5 is formed in a vertical plane, and the field of another side is formed in the slant face. The tip part of the lower electrode 7 is similarly formed in edge shape. The rollers 42e and 42f of the 1st guide means 41 are arranged along the slant face of the upper electrode 5. The rollers 72f and 72g of the 2nd guide means 71 are also arranged along the slant face of the lower electrode 7.

[0048]In the 2nd example constituted in this way, Welding becomes possible enough, even when the vertical wall surfaces 10c and 10d are adjoined as the joined part of the weldment 10 shows drawing 8 since the tip part of the upper electrode 5 and the lower electrode 7 is formed in edge shape and the band-like conducting materials 21 and 51 are guided along the outside surface of each electrode.

[0049]3rd example drawing 9 shows the 3rd example of this invention. This example differs only in the lower electrode 7 from the 1st example. It is formed in the shape where the lower electrode 7 can advance into the crevice of the weldment 10, in this example. The tip part of the lower electrode 7 is formed in the cylinder part of a byway.

The cylindrical root side is formed in the taper part.

The rollers 72f and 72g of the 2nd guide means 71 are arranged so that the cylinder part and taper part of the lower electrode 7 may be met.

[0050]Even if the weldment 10 is carrying out complicated shape, the lower electrode 7 can be made to enter into a narrow portion in the 3rd example constituted in this way, since the tip part of the lower electrode 7 is byway-ized and the band-like conducting material 51 is guided along with the tip part of the lower electrode 7. Therefore, even if the weldment 10 is shape with boom hoisting like a vehicle body, it becomes possible to fully correspond to this. If the tip part of the upper electrode 5 is further byway-ized like the lower electrode 7 and the 1st band-like conducting material is guided along with this, the flexible correspondence over positioning will still be attained.

[0051]

[Effect of the Invention]According to this invention, the following effects are acquired.

[0052](1) Since the 1st band-like conducting material rolled round by the 1st rolling-up means is made to intervene between an upper electrode and a weldment and it was made to make the 2nd band-like conducting material rolled round by the 2nd rolling-up means between a lower electrode and a weldment intervene, It becomes possible to perform resistance spot welding in the state where the new portion of the band-like conducting material was made to always intervene, and consumption with an upper electrode and a lower electrode can be controlled. Therefore, even if the number of welding RBIs increases remarkably, the tip diameter of each electrode can hardly change, but can maintain welding current density almost uniformly. As a result, welding quality can be uniformly maintained over a long time, and it becomes unnecessary [the complicated correction control of the welding current

accompanying consumption of an electrode] like before.

[0053](2) Since the 1st band-like conducting material is guided so that the outside surface of an upper electrode may be met by the 1st guide means, and the 2nd band-like conducting material was guided so that the outside surface of a lower electrode might be met by the 2nd guide means, Even when the weldment is carrying out complicated shape, it becomes possible to locate an upper electrode and a lower electrode in the joined part of a request of a weldment. Therefore, with the shape of a weldment, most things which spot welding working becomes impossible are lost, and the capability can fully be demonstrated in the spot welding especially using a welding gun.

[0054](3) Since the abnormalities in rolling up of a band-like conducting material are detected by the control means when either running torque values of the 1st rolling-up means and the 2nd rolling-up means differ greatly compared with the time of normal, when abnormalities are detected, resistance-spot-welding work can be stopped automatically. Therefore, the spot welding in the state where a band-like conducting material does not intervene can be avoided, and the reliability of a device can be improved.

[Translation done.]